Review of Environmental and Ecosystem variables relevant to assessments: *In-situ* Oceanographic Data and Remote Sensing Sea Surface Temperature and Chlorophyll Concentration

Jon Hare and Kevin Friedland, Narragansett Laboratory

These data will help address terms of reference F.2 and F.3. Changes in the length at age, maturation, and length-weight relationships of various stocks may be caused by changes in ecosystem conditions. Temperature conditions may be acting directly on species via change in metabolic demands caused by higher temperatures, or indirectly via temperature effects on the ecosystem. Changes may also be evident at the base of the food chain that may affect somatic and reproductive growth.

In-situ Oceanographic Data

The Northeast Fisheries Science Center (NEFSC) has several *in situ* oceanographic datasets that could be analyzed on the context of changes in fish weight-at-age. Water column temperature and salinity influence can influence fish growth in a number of ways including through effects on metabolism, consumption, and distribution. Water column temperature and salinity have been measured since the mid-1970's from Cape Hatteras to the Scotian Shelf. Temperature and salinity measurements contemporaneous with trawl survey measurements began in 1992. Currently, the entire shelf region is covered at six times per year, with approximately 2000 CTD per year. These data are stored in Oracle Databases and several parameters can be extracted. Typically, surface and bottom temperature and salinity are used as measures of hydrographic variability, and these variables are described in more detail in Mountain (2005).

In addition to these in situ temperature and salinity measurements, the NEFSC has been monitoring plankton over the shelf since the mid-1970's. Zooplankton abundances provides an overall measure of secondary productivity in the system and may have an general affect on fish growth. In addition, the growth of specific fish species may be affected by the abundance of zooplankton species which serve as prey. The NEFSC has maintained a monitoring program that uses a 60 cm bongo net with 333 μm net towed obliquely to provide depth-integrated collections of zooplankton. The level of sampling effort has changed over the decades, but the minimum effort is about six shelf-wide coverages per year with 120 samples per coverage. These collections have provided estimates of zooplankton biomass (Kane 1993), species abundance (Kane 2003), and community structure (Kane 2007). These data are stored in an Oracle Database and data can be provided for the whole ecosystem of specific sub-regions of the ecosystem.

The next in applying these data to the questions of the GARM is to define the appropriate spatial and temporal partitioning of the data. Once these partitions are defined, the appropriate data can be extracted from the hydrographic and zooplankton databases and used in various analyses.

Sea Surface Temperature (SST)

ERSST-The Extended Reconstructed Sea Surface Temperature (ERSST, version 2) dataset is based on the temperature compilation of the International Comprehensive Ocean-Atmosphere Data Set (ICOADS) SST dataset and represents interpolation procedures that reconstructs SST fields in regions with sparse data (Smith and Reynolds, 2003; Smith and Reynolds, 2004). The data series begins in January 1854, but the signal is heavily damped before 1880 since the data is most limited; SST estimates are more consistent after 1880. The spatial resolution of the data is 2° longitude by 2° latitude bins and the temporal resolution is monthly.

OISST-The optimum interpolation (OI) ocean sea surface temperature database version 2 is produced weekly on a 1° grid and uses in situ and satellite SST plus SST simulated by sea-ice cover (Reynolds et al., 2002). Before analysis, satellite data are adjusted for biases using the methods of Reynolds (1988) and Reynolds and Marsico (1993).

Pathfinder and MODIS-The Pathfinder satellite SST dataset is derived from the Advanced Very-High Resolution Radiometer onboard the Polar Orbiting Environmental Satellite (AVHRR-POES). The MODIS datasets are derived from the MODIS Aqua and Terra sensors. The data represents the near-surface ocean temperature, and is available at a spatial resolution of 9km and a temporal resolution of 8-day periods.

Chlorophyll Concentrations

Chlorophyll *a* concentrations were derived from the Sea-viewing Wide Field of View Sensor (SeaWiFS) onboard the SeaStar spacecraft. The level-3 processed data is available at the NASA Ocean Color Website: http://oceancolor.gsfc.nasa.gov/).

Primary Productivity

Estimates of net primary productive are based on the Vertically Generalized Production Model (VGPM) of Behrenfeld and Falkowski (1997). This chlorophyll based model uses a temperature dependant relationship for photosynthetic efficiency. These data are available via the Ocean Productivity Website and were also sampled at a temporal frequency of 1 month (http://web.science.oregonstate.edu/ocean.productivity/index.php). Primary productivity computed via the Eppley-VGPM and the Carbon-based Production Model (CbPM) methods are also available.

The remote sensing datasets (see tables below) are a subset of the full offerings of data on SST and primary and secondary productivity; they were selected to address the range of spatial and temporal comparisons needed to test the subject terms of reference.

References

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Tables showing spatial and temporal coverage of remote sensing parameters.

SST

Dataset	Spatial Resolution	Temporal Resolution	Time Coverage	Source	Missing Data
ERSST	2x2°	monthly	1854-present	Ship, buoys, etc.	No
OISST	1x1°	7-day, monthly	1982-present	Satellites	No
Pathfinder	9km	8-day, monthly	1985-2001	Satellites	Yes
MODIS	9km	8-day, monthly	2002-present	Satellites	Yes

Chlorophyll

Dataset	Spatial Resolution	Temporal Resolution	Time Coverage	Source	Missing Data
SeaWiFS	9km	8-day, monthly	1998-present	Satellites	Yes
MODIS	9km	8-day, monthly	2002-present	Satellites	Yes

Primary Productivity

Dataset	Spatial Resolution	Temporal Resolution	Time Coverage	Source	Missing Data
SeaWiFS VGPM	9km	monthly	1998-present	Satellites	Yes